

# Technical Information Report

Flow Control Excerpt

Beta Townhomes

11801 NE 116<sup>th</sup> Street  
Kirkland, WA 98034

Prepared for Quadrant Homes

Prepared by BCRA

February, 2016



ARCHITECTURE + INTERIOR SPACES  
SCIENCE + ENGINEERING  
PLANNING + LANDSCAPE ARCHITECTURE

# TECHNICAL INFORMATION REPORT

## FLOW CONTROL EXCERPT

02/22/2016

**PROJECT:**

Beta Townhomes  
11801 NE 116<sup>th</sup> Street  
Kirkland, WA 98034

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I hereby state that this report for the Beta Townhomes project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers.

**PRELIMINARY**

## PART D – FLOW CONTROL SYSTEM

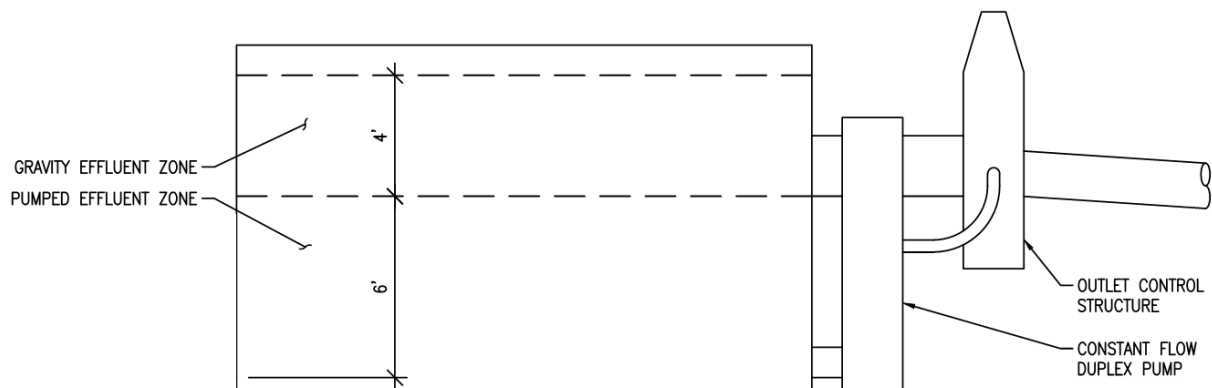
The design of the site's flow control system was completed using the Western Washington Hydrology Model (2012WWHM). The site was modeled as a single basin and was designed to match the developed discharge durations of the site to the predeveloped discharge durations of the site for 50% of the two year storm to the 50 year storm. The predeveloped condition was taken to be a forested site.

As the site contains various constraints to the storm system such as low vertical drop across the site and a relatively high storm system within 116th street to which the system would connect it was determined that a traditional detention system would be neither practical nor cost effective for the developed site. With the variety of site constraints compounding in effect the available vertical drop within the proposed system that could be used in a traditional detention system was found to be roughly 4 feet. Under code regulations that dictate a minimum detention vault depth of 7 feet a traditional detention vault would produce an appreciable amount of dead storage that would not be available for mitigating the proposed development.

Outside of traditional gravity drained detention systems the options for flow control become sparse. An investigation into the possibility of using storm pumps was done however, the difficulty of using storm pumps to match the proposed discharge durations to a forested conditions discharge durations can be all but prohibitive and as was deemed as a last option for the site's flow control system.

Based on these two investigations a third, hybrid, approach was developed. By combining both a gravity fed system and a stormwater pump the proposed design is able to take advantage of the depth allowed by a pumped system with the duration matching ability of a gravity drained system. The hybridized system is a detention vault that is effectively broken into two different zones, one zone drained by the storm pump and the other drained by a gravity outlet (See Figure 4-1 below).

**Figure 4-1: Detention Exhibit**



The function of each zone is aimed at serving different storm events.



### Pump Effluent Zone

As the pumped zone is lower than the gravity zone the pump is designed mainly to meet the smaller storm events. The pump was thus sized to discharge at a constant rate below the 50% of the two year peak flow rate. This zone functions in small storm events as a constant release at less than 50% of the two year and in larger storm events as a bleeder for the system discharging at the same low flow as before.

### Gravity Effluent Zone

As the gravity zone is above the pumped zone it is designed mainly to serve the larger storm events. The gravity system was designed in concert with the pumped zone to provide discharge duration matching for the larger storms up to the 50 year storm. Functioning with a riser and several orifices at various elevations the gravity outlet was able to be designed to mirror the discharge characteristics of the forested site. This zone is not used in small storm events however is used to control flows in larger storm events with the assistance of the low flowrate benefit provided by the stormwater pump. A discovered advantage to this hybrid system is that in the event of a loss of power of pump malfunction the gravity outlet serves not just as an emergency overflow for the system but does so in a controlled manner.

As you can see above the combination of these two systems principals in this hybridized system not only meets the intent of the code but also provides a number of benefits to both the site and the City's system. Included below is a summary of the calculations used to size the system. As well as analysis output verifying the designs conformance with the 2009 King County Stormwater Management Manual (2009 KCSWMM) and the City of Kirkland Amendments.

**Figure 4-2: WWHM Layout - Predeveloped**



Figure 4-3: WWHM Input - Existing Basin A

Basin A Predeveloped

Subbasin Name: Basin A

Flows To : Surface Interflow Groundwater

Area in Basin ☒ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
<input checked="" type="checkbox"/> C, Forest, Flat	4.34	<input checked="" type="checkbox"/> ROADS/FLAT	0
<input checked="" type="checkbox"/> C, Lawn, Flat	0	<input checked="" type="checkbox"/> ROOF TOPS/FLAT	0
		<input checked="" type="checkbox"/> SIDEWALKS/FLAT	0

Pervious Total 4.34 Acres

Impervious Total 0 Acres

Basin Total 4.34 Acres

Deselect Zero Select By: GO

Figure 4-4: WWHM Layout - Mitigated



Figure 4-5: WWHM Input - Basin 1

Basin 1 Mitigated

Subbasin Name: Basin 1 ☐ Designate as Bypass for POC:

Flows To : Surface Interflow Groundwater

Area in Basin ☒ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
<input checked="" type="checkbox"/> C, Forest, Flat	0	<input checked="" type="checkbox"/> ROADS/FLAT	1.16
<input checked="" type="checkbox"/> C, Lawn, Flat	1.39	<input checked="" type="checkbox"/> ROOF TOPS/FLAT	1.47
		<input checked="" type="checkbox"/> SIDEWALKS/FLAT	.32

Pervious Total 1.39 Acres

Impervious Total 2.95 Acres

Basin Total 4.34 Acres

Deselect Zero Select By: GO

Figure 4-6: WWHM Input - Detention

Detention Mitigated

Facility Name: Detention

Flows To :

☐ Precipitation Applied

☐ Evaporation Applied

☐ Manual Infiltration

Facility Type: SSD TABLE

Load File: Browse

☐ Stage Computed Add Layer

	Stage (ft)	Area (acres)	Storage (acre-ft)	Manual	Not Used	Not Used	Not Used	Not Used
1	0.000000	0.146900	0.000000	0.000000				
2	0.250000	0.146900	0.036700	0.062200				
3	0.500000	0.146900	0.073500	0.062200				
4	0.750000	0.146900	0.110200	0.062200				
5	1.000000	0.146900	0.146900	0.062200				
6	1.250000	0.146900	0.183700	0.062200				
7	1.500000	0.146900	0.220400	0.062200				
8	1.750000	0.146900	0.257100	0.062200				
9	2.000000	0.146900	0.293800	0.062200				
10	2.250000	0.146900	0.330600	0.062200				
11	2.500000	0.146900	0.367300	0.062200				
12	2.750000	0.146900	0.404000	0.062200				

Tide Gate Time Series Demand

Determine Outlet With Tide Gate

☐ Use Tide Gate

Tide Gate Elevation (ft) 0 Downstream Connection

Overflow Elevation (ft) 0 Iterations 0

Initial Stage (ft) 0

Item	Invert (ft)	Diameter (in)	Width (in)
Orifice 1	6.00	1.25	-
Orifice 2	7.00	1.25	-
Orifice 3	8.00	1.00	-
Notch	9.00	-	1.00
Rim	10.00	24.00	-

**Note:**

The two year peak flow rate for the predeveloped site was found to be 0.1276 cfs (as seen in Figure 4-8). The stage storage discharge table above was constructed with the pump flow of 0.0622 (approximately 50% of the two year predeveloped peak flow rate) and the outlet control structure shown above.

Figure 4-7: WWHM Output - POC 1 Duration Analysis

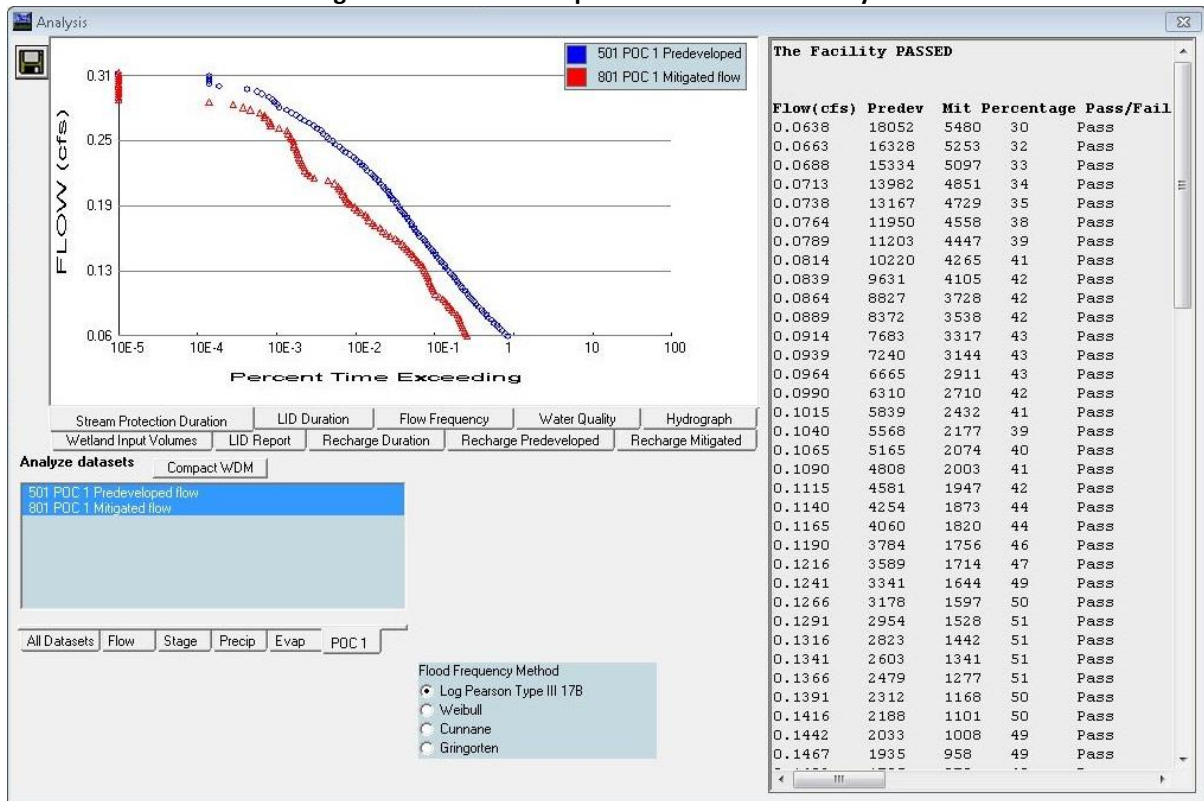


Figure 4-8: WWHM Output - POC 1 Flow Frequency Analysis

